Why Are We Talking About Capacity Markets?

Workshop on Market Design and Operation With Variable Renewables

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Jun 22, 2011

NREL/PR-5500-52138
Outline

• Overview of capacity and why we are discussing capacity markets.

• Principles of efficient markets.

• Difficulties with capacity markets.

• The way forward.
Motivation for Capacity Markets

- Ensure investment/development of sufficient capacity;
- Overcomes some of the difficulties with relying on only an energy market;
- Metric is difficult issue – addressed later;
- Does not directly address “operational capacity.”
High Penetrations of Wind/Solar

- Wind and solar (depending on technology) tend to have low contribution to planning reserves:
  - energy resources supply less capacity;
  - Partial separation of capacity and energy into more specialized resources.
- Wind/solar tend to induce lower capacity factors from conventional units.
- Wind/solar tend to increase the need for flexible capacity.
Market Properties

• What does the power system need to do?
• What are the attributes of a system that can provide for these needs reliably and economically?
• How do we design market(s) to provide for these needs?
What Does the Market Reward?

• Whatever it is, you will get some, even if it is the wrong thing.

• Examples of markets-gone-bad:
  – Executive compensation in the early 21 century in the U.S.;
  – Market rules/constraints imposed in California during the power crisis.

• Market rules, metrics, and structure can drive behavior.

• So...it is important to know what to ask for and how to measure it.
Principles of Competitive Markets

• Efficient: providing what society values most highly in cost-effective way;
• Transparent information to all buyers and sellers;
• Prices are an efficient signal;
• No externalities, free riders, or public goods;
• Sellers have no market power;
• Buyers have no market power;
• One then can prove:
  – Long-run equilibrium is stable;
  – Long-run equilibrium: \( P = MC = \min(ATC) \) which assures revenue sufficiency and social optimum.
Long-run Competitive Equilibrium
Electricity (energy) Markets (most other markets too) Are Only Partially Competitive

- Expression of demand is muted by the absence of dynamic pricing → price signals are ineffective;
- Elements of supply (transmission, reliability) have attributes of public goods and potential free riders;
- Reliability can’t be easily purchased or valued;
- Market power often exists and can be significant;
- Some resources (wind, solar) have near-zero marginal cost;
- Implication: MC pricing will not likely allow for revenue sufficiency for some generators.
Implication: Energy Market will not Deliver an Economically Efficient Solution

- Point A: excess capacity
- Point B: insufficient capital recovery
Capacity Markets

- Purpose: to incent investment in new generation in the absence of transparent signals that would result from efficient market.
- In principle, this should be easy.
- In practice, it is very difficult.
What Are We Asking the Capacity Market to Provide?

- Sufficient capacity to provide for a target reliability.
- This would suggest a reliability-based metric to measure capacity contribution.
Effective Load-carrying Capability

Each generator added to the system helps increase the load that can be supplied at all reliability levels.
Data and Metric Issues

- Capacity market is essentially a future market.
- What forced outage rate (FOR) to use on conventional generation?
- Availability or performance? Trust but verify?
- FOR over non-maintenance hours?
  - Can this be gamed?
- How many years of wind/solar data are needed?
- What is reliability worth?
- Value of lost load (VOLL)?
- How do consumers purchase it and how do you measure it?
- How do you eliminate free riders?
Reliability Can Come from Many Sources

Incremental ELCC from Overlay

### Wind Only

- **2004**: Blue bars
- **2005**: Red bars
- **2006**: Green bars

### Wind with Overlay

- **2004**: Blue bars
- **2005**: Red bars
- **2006**: Green bars

Bar charts showing incremental ELCC from 2004 to 2006 for different years and scenarios.
Other Issues

- Interdependency of generators/transmission contributions to reliability;
- Monthly capacity market?
- Annual capacity market?
Inter-annual Variability is Real

MW size also important!

Minimum = 0
Other Potential Metrics

- Planning reserve market.
PRM is Silent Regarding Reliability

Based on adding 54x100MW units @ 10% FOR to meet 1d/10y.
Increasing the FOR means the reserve margin must increase to maintain reliability.
Simplifications

- Actual capacity factor calculated over high-risk periods;
- ISO-NE, NYISO, PJM all do something similar;
- Requires periodic “true-up” with a full reliability calculation;
- Advantage: takes individual generator performance into account (not by class/size);
- Disadvantage: lack of wind/solar data.


Some Potentially Useful Principles

- Horizontal consistency;
- Vertical consistency;
- Ability to account for multiple technologies using the same metric;
- “Thought experiments:”
  - What does the metric ask for?
  - Is that what we want?
  - If suppliers provide what the market asks for and values, do we achieve the objective?
  - Are there any perverse incentives?
Let the discussion begin